

REMARKS

Claims 1 and 3-7 have been amended. Claims 1-7 are presently pending.

The specification has been amended to add section headings and to correct a typographical error uncovered during further review of the application. In addition, a new abstract, substantially identical to the original abstract, has been submitted as a separate sheet. Accordingly, the Examiner's objections to the specification and abstract have been overcome and should be withdrawn.

In view of such amendments and the following remarks, reconsideration and allowance of the claims, as presently presented, are respectfully requested.

EXAMINER'S ACTION

The 35 U.S.C. §§ 112 Rejections and Claim Objections

The Examiner objected to claim 2 for including informalities, and also rejected claim 2 under 35 U.S.C. § 112 ("Section 112"), second paragraph. Claim 2 been amended to correct a typographical error, so that the intensity for the first of the three listed intensity equations is labeled I₀. In addition, the Examiner is respectfully directed to page 5, lines 16-30 and page 7, lines 3-15, which recite the intensity equations of the claimed invention and provide support for identifying the intensities of the light combinations as I₁ and I₂ in claim 2. Further, claim 2 has been amended to clarify its wording and recites, in relevant part, that the phase difference between the light from the first and second paths is determined based on the interference intensities that result from combining the light from the first and second paths with each other in three combinations with respective relative phase shifts. Based on the amendments of claim 2, the Examiner's objection to claim 2, and also Section 112 rejection of claim 2, have

been overcome and accordingly should be withdrawn.

Further, the Examiner rejected claim 5 under Section 112, second paragraph, for not clearly reciting "how the path length controller can directly control the calculated phase difference." Claim 5 has been amended to clarify that the controller controls the "path length difference between the first and second paths based on the calculated phase difference." (See specification at pg. 3, ln. 19-20 and pg. 6, ln. 15-20).

Accordingly, based on the amendment of claim 5, the Examiner's rejection of claim 5 has been overcome and should be withdrawn.

The 35 U.S.C. § 101 Rejections

Independent claims 6-7 were rejected under 35 U.S.C. § 101 ("Section 101") as being directed to non-statutory subject matter. The Examiner's rejection is respectfully traversed.

The Examiner admitted that claims 6-7, each of which recites the requirement of "calculating a phase difference" between light from the first and second paths while eliminating an effect of a contrast between the light from the first and second paths, are useful and concrete, but do not recite a tangible result. According to the Examiner, the outcome of the calculation, namely, the phase difference, "has not been used in a disclosed practical application nor made available in such a manner that its usefulness in a disclosed application can be realized."

Without acknowledging the propriety of the Examiner's rejection, to expedite prosecution claims 6-7 have been amended to recite that the phase difference is supplied "to a control system coupled to at least one of the first and second paths". (See specification, for example, page 6, lines 15-20, and page 7, lines 19-25; FIG. 1).

Referring to the exemplary implementation of the claimed invention set forth in the specification, amended claims 6-7 produce a tangible, real-world result, because the phase difference is a fixed and reportable data value (see specification, for example, at page 5, lines 16-30), which is supplied as a feedback signal to a control system (e.g., a path length controller 19 coupled to a calculation unit 18) coupled to at least one of the first and second paths. The (controller 19 of the) control system, in turn, uses the phase difference to control the path length difference between the first and second paths. (See specification, for example, at page 6, lines 15-20). It is well known in the art that, in an optical energy signal system in which an optical energy signal is transmitted over two optical paths, it is often desirable to control the path length difference between the two optical paths in the system. (See specification, for example, at page 1, lines 11-12). Thus, the supply of the phase difference to a control system, which can control optical path length difference between the two optical paths based on a determination of the phase difference between the light from the two paths as required by claims 6-7, is a practical, real world application.

Accordingly, the rejections of claims 6-7 under Section 101 should be withdrawn.

The 35 U.S.C. § 103 Rejections

Claims 1 and 3-7 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Fuest, R., *Integrated Optical Michelson-Inteferometer with quadrature phase demodulation in glass for displacement measuring*, TM Technisches Messen 58, No. 4 (April 1991), pp. 152-157 ("Fuest"). Independent claims 1 and 6-7, and claims 3-5 which depend from claim 1, clearly are patentable over Fuest.

Independent claim 1 is directed to an apparatus for measuring an optical path length difference including, in relevant part, "an at least three-way coupler to combine light from [t]he first and the second paths with each other in at least three combinations with at least three mutually different added relative phase displacements." Claim 1 requires that a detector measures "interference intensities of the at least three combinations", and further that "a calculation unit" determines "from the intensities, a phase difference between the light from the first and second paths while eliminating an effect of a contrast between the light from the first and second paths." Advantageously, the inventive apparatus measures the optical path difference between two optical paths, such that the path length difference can be controlled (eliminated), without performing the complicated measurements that are generally required to determine the amplitude ratio (contrast) between the light from the two paths. (See specification, for example, page 2, lines 9-24). Based on the interference intensities at the outputs of the three-way coupler as required by claim 1, the phase difference between the light from the two optical paths can be calculated independently of the amplitude ratio (contrast) of the light from the two optical paths, such that the optical path length difference between the paths can be determined from the phase difference where contrast is unknown. (See specification, for example, page 2, lines 20-28, and page 6, lines 13-15).

The Examiner admitted that Fuest fails to teach a calculation unit that "eliminates" an effect of contrast between light from first and second paths. Fuest merely confirms what is conventional in the art, namely, that it is desirable to have a predetermined or zero contrast when determining path length difference between two optical paths. Fuest teaches away from the claimed invention by attempting to control

contrast, whereas the claimed invention does not attempt to control contrast when measuring optical path length difference. Instead, the claimed invention accepts the existence of an unknown contrast, and uses interference intensity information at an least three-way coupler, which is coupled to the optical paths, to eliminate the *effect* of contrast. In the claimed invention, the phase difference between the light from the two paths, and hence the optical path length difference between the paths, is determined in the absence of measurement or control of the contrast. Nowhere does Fuest teach or suggest eliminating the effect of contrast when measuring an optical path length difference between two paths, and in particular, using a three-way coupler to combine light from the first and second paths with each other with different relative phase displacements to provide that the phase difference between the light from the paths can be calculated independent of the contrast between the light from the two paths, as required by claim 1.

Accordingly, claim 1 is patentable over Fuest.

In addition, independent method claim 6 and product claim 7, each of which includes limitations corresponding to those of claim 1 discussed above concerning the calculation of a phase difference between the light from first and second paths while eliminating an effect of the contrast between the light from the first and second paths, also are patentable over Fuest for the same reasons as set forth above with respect to claim 1.

Further, claims 3-5, which depend directly from claim 1, are also patentable over Fuest for the same reasons as set forth above with respect to claim 1 and because of the further restrictions they add.

Withdrawal of the Section 103 rejections is, therefore, respectfully requested.

Allowable Subject Matter

The Examiner stated that claim 2 includes allowable subject matter, and would be allowable if re-written to overcome the Section 112, second paragraph, rejections and include all of the limitations of the claim upon which it depends.

Claim 2 has been amended to become an independent claim including all of the limitations of claim 1, upon which claim 2 had depended, and also to overcome the Section 112 rejections and formal objections, as discussed above.

According, claim 2 has been placed in allowable form and should be allowed on the next Action.

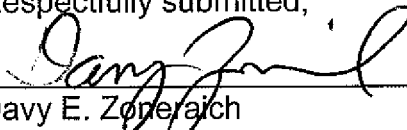
CONCLUSION

For the foregoing reasons, it is believed that all of the claims, as presently presented, are patentable.

The Examiner is invited to telephone the undersigned if it is believed that further amendment and/or discussion would help to advance the prosecution of the present application.

Reconsideration and allowance of claims 1-7 are, therefore, respectfully requested.

Respectfully submitted,



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